Space Weather Technical Forecast

Issued on Sunday, 26 March 2023 at 00:37 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of R1 Minor radio blackouts. Active electron fluence Likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional minor C-class flares recorded at GOES16. There are eight Active Regions on the visible disc at present. AR3256 is the only region with a complex magnetic structure, though there have been no significant flares from this group. AR3258 showed some growth and slight increase in complexity but the other 6 regions are mostly benign and simple.
No Earth-directed CMEs were observed in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by DSCOVR, has been in the High Speed Stream from negative polarity CH86, reaching elevated levels around 550 km/s by the end of the period. The phi angle was negative. The solar wind density was average or just above average, reaching 12 ppcc for long periods. The IMF fell from 10 nT to around 6 nT. The north-south component was negative for long periods, though mostly weak, with a range of +8/-7 nT observed. The net result of the above solar wind measures was for Quiet to Unsettled (Kp 2-3) with an Active (Kp4) interval between 25/0600-0900 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 remained at Background levels. The high energy electron flux (greater than 2MeV) measured at GOES16 has increased into Moderate. The associated 24-hour fluence remained below the Active (1e8 integrated pfu) threshold, although now with a rising trend. At 25/2359 UTC the observed fluence was 2.25e7 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is most likely to remain Low, but with a Chance of becoming moderate with any isolated M-class flares. The main region likely to give such flares is AR3256 in the southwest.
Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the forecast. Earth is currently within a High Speed Stream from CH86/-. Wind speeds are likely to remain elevated through day 1 (26th) before beginning to slowly ease thereafter.
Geomagnetic activity should peak early in the forecast period with Unsettled (Kp3) intervals and a chance of Active (Kp4), before becoming largely Quiet once again from day 2 (27th) as the fast wind wanes.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to remain at Background levels, but with a Slight Chance of reaching S1 or greater, should any significant flares occur.
The high energy (greater than 2 MeV) electron flux is currently showing a degree of recovery and is likely to rise further, probably breaching the 1000 pfu High Threshold at diurnal maximum each day through the period. The associated 24-hour fluence is expected is also expected to rise, with Active (1e8 integrated pfu) conditions becoming Likely from day 2 (27th).

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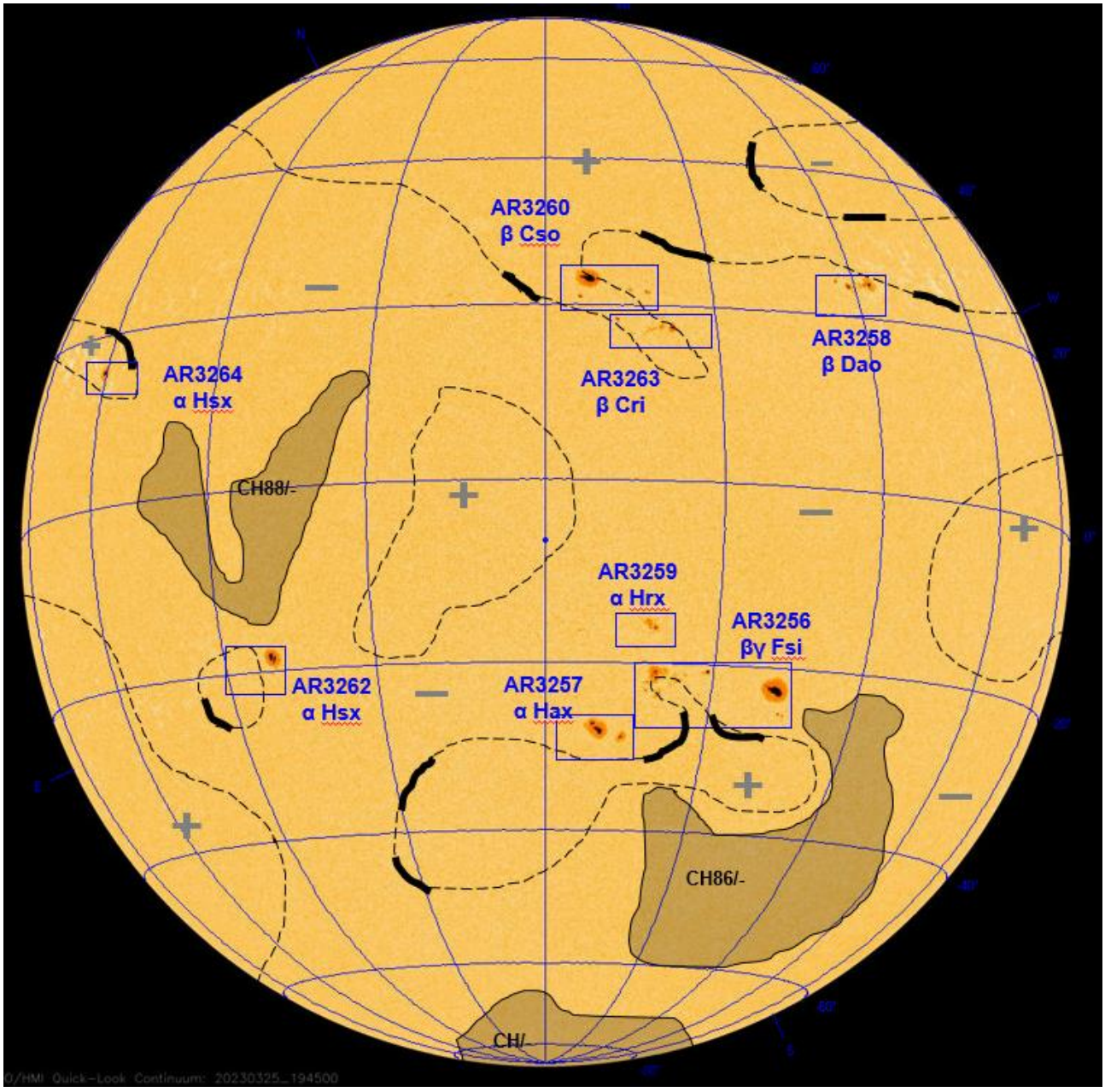
Figure 1. Solar Analysis Valid 25/2000 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

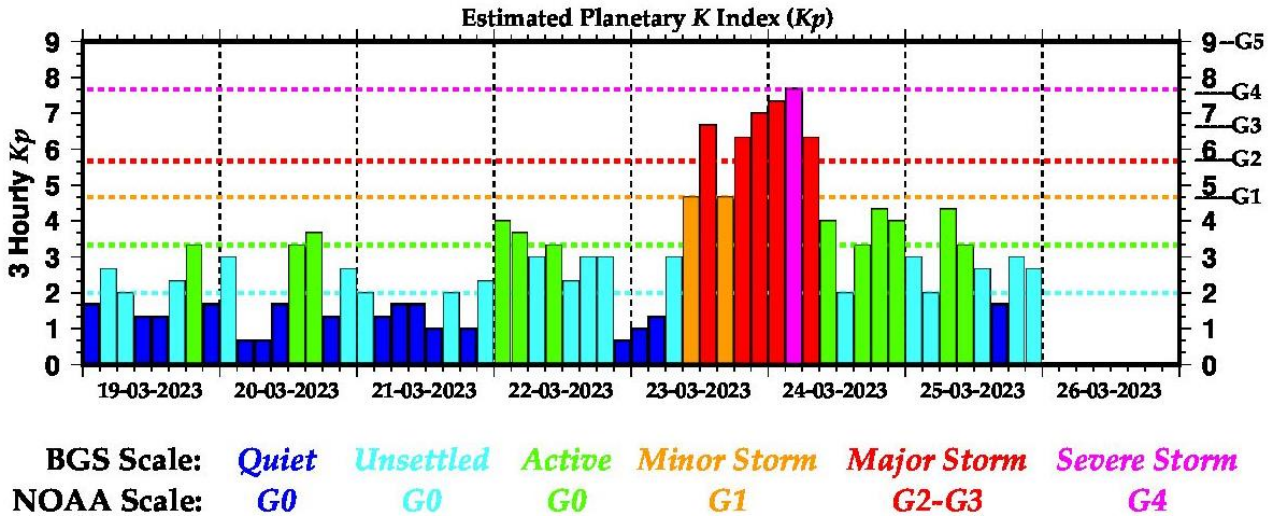
No further Earth directed CMEs are currently forecast.

The four-day forecast therefore solely comprises of the High Speed Stream enhancement from CH86/- which is already connected to Earth.
Ch86/- is both changed relative to last pass, but also relative to the past few days, with its northern promontory having closed up somewhat, else being largely masked in EUV by flux emanating from AR3256 to its immediate east. Added to this is the fact that STEREO A MAG and PLASTIC measurements to provide a day's forecast upwind are currently very erratic and sparse, and also the fact that the past rotation was heavily polluted by a CME arrival, all add up to a relatively low confidence forecast. In addition, MOSWOC Enlil has only a very tenuous grasp of solar wind conditions at present.
Having said all the above, the coronal hole is showing its character at L1, and the solar wind speed now appears to be plateauing near 520 km/s. The solar wind is perhaps likely to remain near this level through day 1 (26th) before waning from day 2 (27th).
The chances of significant geomagnetic activity are now much-reduced relative to the recent past, with activity expected to peak in the next 24 hours with Unsettled periods and a chance of Active, before waning in earnest to Quiet conditions into the new working week.

Geo-Magnetic Storm / Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

Figure 2: BGS Estimated Planetary K index



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Radio Blackouts - X-Ray Flares:

There are currently eight sunspot regions on the visible disc, although only one of these is nominally large and magnetically complex, thus far the effect on X-ray activity has been muted. Relative to the raw whole-disc probability of near 60% daily chance of M-class flares, a heavy degree of moderation has taken place, with C-class flares currently barely being registered at GOES16. It remains the case that it would not take much development in order for flare activity to increase however, and for this reason a Chance of M-class is maintained throughout. Regarding the balance of front-side groups, none leave in the four days, while the Carrington locations for up to four regions are due. These do not yet feature in the forecast, with assessment as to any increase in risk they may deliver pending their arrival over the eastern limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16 is currently at Background levels.

Proton flux is most likely to remain at Background levels, but with a slight chance of reaching S1 or greater should any larger flares occur. The current disc is perhaps under-performing relative to its potential in terms of flares, however the threat remains, and should the sunspot begin to flare appropriately, the risk of S1 events may be adjusted upwards over the four days to account for their westward progress.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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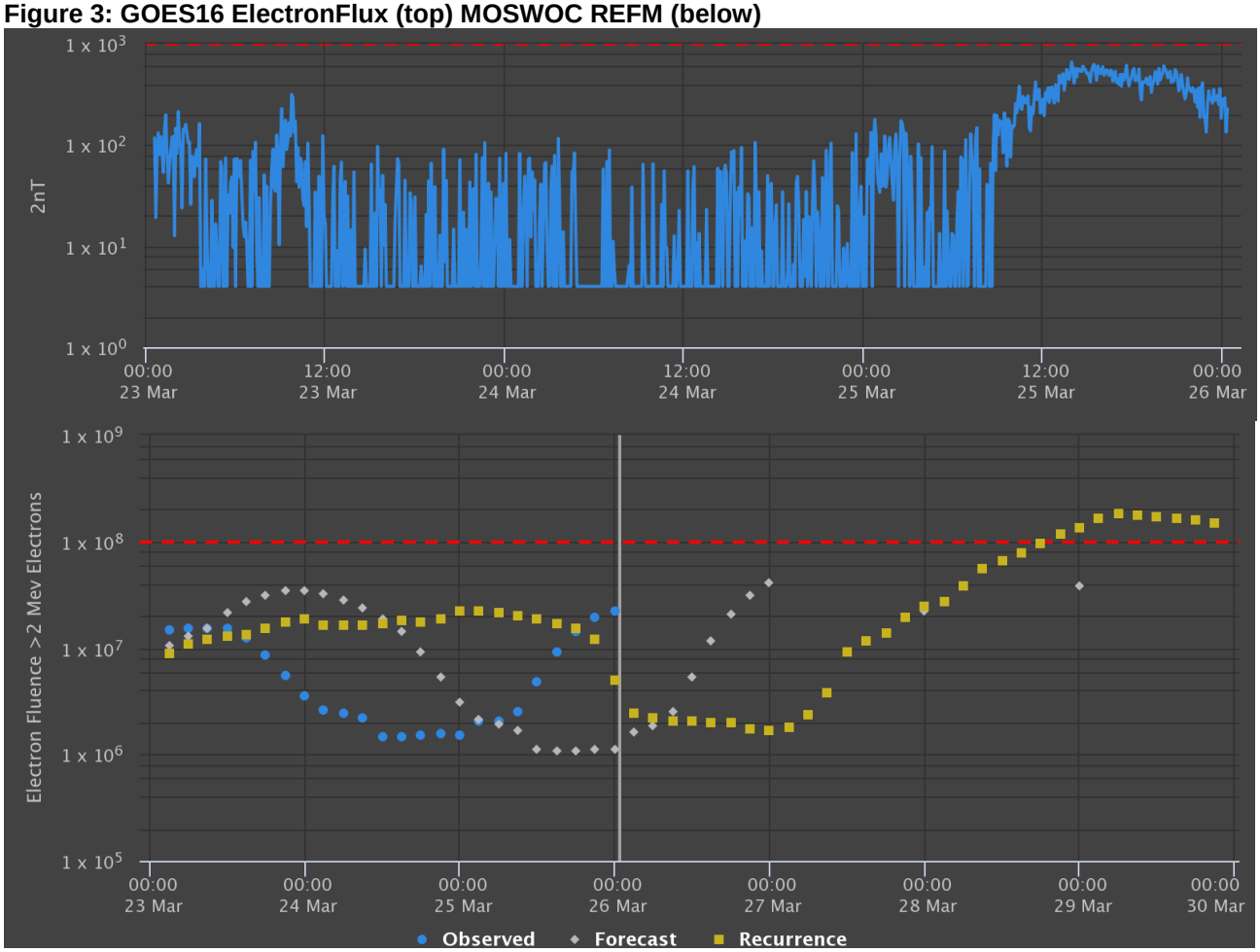
High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux is showing a degree of recovery now peaking at Moderate levels. There is considered a reasonably strong potential for further day-on-day increases in flux over the next 4 days with the 1000 pfu High threshold likely breached at diurnal maximum each day.
Active 24-hour integrated electron fluence perhaps carries a Chance of being realised on day 1 (26th). Given current observed values are significantly above forecast values there is a likelihood that Active fluence levels will be reached from late day 1 (26th) or day 2 (27th).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	50	60	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: GOES16 ElectronFlux (top) MOSWOC REFM (below)



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